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The application is published incomplete as filed (Article 93 (2) EPC). The point in the description and the claim(s) at which the omission obviously occurs has been left blank.

A request for addition of a part of the description and of the second part of claim 14 has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 2.2).

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(54) Method for cleaning drains.

(57) A thickened aqueous cleaning composition which is viscoelastic, and has utility as a drain opening composition or as a hard surface cleaner having a cleaning-effective residence time on non-horizontal surfaces. In one embodiment the composition comprises a cleaning active, a quaternary ammonium compound, and an organic counterion. In another embodiment, the viscoelastic quality of the composition is advantageously utilized as a drain opener which rapidly penetrates standing water with minimal dilution to deliver active to the clog mat rial.

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The pres nt invention relates to a method for cleaning drains, in particular to a method using thickened cleaning compositions having a viscoelastic rheology.

Much art has addressed the problem of developing a thickened cleaning composition which may contain a bleach and may have utility as a hard surface cleanser. The efficacy of such compositions is greatly improved by viscous formulations, increasing the residence time of the cleaner. Splashing during application and use is minimized, and consumer preference for a thick product is well documented. Schlip. U.S. 4,337,163 shows a hypochlorite thickened with an amine oxide or a quaternary ammonium compound, and a saturated fatty acid soap. Stoddart U.S. 4,576,728 shows a thickened hypochlorite including 3- or 4-chlorobenzoic acid, 4-bromobenzoic acid, 4-toluic acid and 3-nitrobenzoic acid in combination with an amine oxide. DeSimone U.S. 4,113,645 discloses a method for dispersing a perfume in hypochlorite using a quaternary ammonium compound. Bentham et al, U.S. 4,399,050, discloses hypochlorite thickened with certain carboxylated surfactants, amine oxides and quaternary ammonium compounds. Jeffrey et al, GB 1466560 shows bleach with a soap, surfactants and a quaternary ammonium compound. For various reasons, the prior art thickened hypochlorite compositions are not commercially viable. In many instances, thickening is insufficient to provide the desired residence time on non-horizontal surfaces. Adding components, and/or modifying characteristics of dissolved components often creates additional problems with the composition such as syneresis, which require adding further components in an attempt to correct these problems. Polymer thickened hypochlorite bleaching compositions tend to be oxidized by the regardless of the effectiveness of the active, if the composition is not fully delivered to the clog, the effectiveness of the active will be diminished or destroyed. This is particularly apparent where the clogged drain results in a pool of standing water, and a drain opener composition added to such standing water will be substantially diluted thereby. The above European Patent Applications of Swann et al disclose an attempt to overcome the delivery problem by encapsulating actives in polymeric beads. The Rogers and Durham et al patents refer to the delivery problem and mention that a thickener is employed to increase the solution viscosity and mitigate dilution. Similarly a thickener is optionally included in the formulation of Jacobson et al. The viscoelastic properties of aqueous detergent solutions based on quaternary ammonium compounds and anionic counterions are discussed in "Journal of Colloid and Interface Science", Vol. 57, No. 3, December 1976, pp 575-577 and in "Siefen-Öle-Fette-Wachse" Illjg, No. 15/1985, pp 467-471.

The present invention provides a method for clearing restrictions caused by organic materials in drain pipes comprising:

(a) introducing to a drain pipe having an organic restriction therein a drain opening composition comprising a cleaning active and a viscoelastic thickening system wherein the composition has a relative elasticity of greater than about 0.03 sec/Pa;

(b) allowing the composition to remain in contact with the organic restriction material to react therewith; and

(c) rinsing the composition and restriction away.

The composition is utilized by pouring an appropriate amount into a clogged drain. The visocelastic thickener acts to hold the active components together, allowing the solution to travel through standing water with very little dilution. The viscoelastic thickener also yields increased percolation times through porous or partial clogs, affording longer reaction times to enhance clog removal. Preferably the composition is of a density which is greater than that of water. Preferably the composition has a delivery rate of greater than about 70%, as determined in the manner described below. Preferably the ionic strength of the composition is at least about 0.09 g-ions/kg.

Viscoelasticity is preferably imparted to the cleaning composition by a system including a quaternary ammonium compound and an organic counterion selected from the group consisting of alkyl and aryl carboxylates , alkyl and aryl sulfonates, sulfated alkyl and aryl alcohols, and mixtures thereof. The counterion may include substituents which are chemically stable with the active cleaning compound. Preferably, the substituents are alkyl or alkoxy groups of 1-4 carbons, halogens and nitro groups, all of which are stable with most actives, including hypochlorite. The viscosity of the formulations of the present invention can range from slightly greater than that of water, to several thousand centipoise (cP). Preferred from a consumer standpoint is a viscosity range of about 20 cP to 1000 cP, more preferred is about 50 cP to 500 cP.

As used herein the t rm "cleaning" refers generally to a chemical, physical or enzymatic treatment resulting in the reduction or removal of unwanted mat rial, and "cleaning c mposition" specifically includes drain openers, hard surface cleaners and bleaching compositions. Th cleaning composition may consist of a vari ty of chemically, physically or enzymatically reactive active ingredi nts, including solvents, acids, bases, oxidants, reducing agents, nzym s, d tergents and thioorganic compounds.

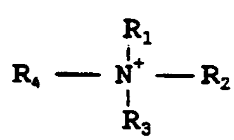
By cleaning active is meant cleaning compounds, or mixtures thereof, suitable for opening drains, which act by either chemically reacting with the clog material to fragment it or render it more water-soluble or dispersable, physically interacting with the clog material by e.g., adsorption, solvation, or heating (i.e. to melt grease), or by enzymatically catalyzing a reaction to fragment or render the clog more water-soluble or dispersable.

A number of cleaning compounds are known and are compatible with the viscoelastic thickener. Such cleaning compounds interact with their intended target materials either by chemical or enzymatic reaction or by physical interactions, which are hereinafter collectively referred to as reactions. Useful reactive compounds are described in EP-A-88309272, from which the present application is divided and which disclosure is incorporated herein by reference. The cleaning active is added in a cleaning-effective amount, which may preferably range from about 0.05 to 50 percent by weight, depending on the active.

The viscoelastic thickener is preferably formed by combining a compound having a quaternary nitrogen, e.g.quaternary ammonium compounds (quats) with an organic counterion. The viscoelastic thickener may be any such thickener yielding properties within the limits set out herein. Polymers, surfactants, colloids, and mixtures thereof, which impart viscoelastic flow properties to an aqueous solution, are also suitable. The viscoelasticity of the thickener advantageously imparts unusual flow properties to the cleaning composition. Elasticity causes the stream to break apart and snap back into the bottle at the end of pouring instead of forming syrupy streamers. Further, elastic fluids appear more viscous than their viscosity indicates. Instruments capable of performing oscillatory or controlled stress creep measurements can be used to quantify elasticity. Some parameters can be measured directly (see Hoffman and Rehage), Surfactant Science Series 1987, Vol 22, 299-239 and EP 204,472), or they can be calculated using models. Increasing relaxation times indicate increasing elasticity, but elasticity can be moderated by increasing the resistance to flow. Since the static modulus is a measure of the resistance to flow, the ratio of the relaxation time (Tau) to the static shear modulus (GO) is used to measure relative elasticity. Tau and GO can be calculated from oscillation data using the Maxwell model. Tau can also be calculated by taking the inverse of the frequency with the maximum loss modulus. GO is then obtained by dividing the complex viscosity by Tau. To obtain the full benefits of the viscoelastic thickener, the Tau/GO (relative elasticity) should be greater than about 0.03 sec/Pa.

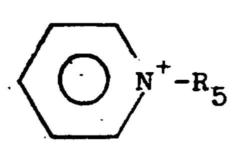
Some consumers do not like the appearance of elastic flow properties. Thus, for certain products the elasticity should be minimized. It has been empirically determined that good consumer acceptance is usually obtained for solutions with Tau/GO less than about 0.5 sec/Pa, although much higher relative elasticities can be formulated. The relative elasticity can be varied by varying the types and concentrations of quat and counterions, and by adjusting the relative concentrations of counterions and quat. The quat is preferably selected from the group consisting of those having the following structures:

(i)



wherein R_1, R_2 and R_3 are the same or different, and are methyl, ethyl, propyl, isopropyl or benzyl, and R_4 is C_{14-18};

(ii)



and;

wher in R_5 is C_{14-18}, alkyl, and;

(iii) mixtur s thereof.

Most preferred, especially if ionic strength is present, is a C_{14-18} alkyl trimethyl ammonium chloride and esp cially cetyltrimethyl ammonium chloride (CETAC). It is noted that when referring to carbon chain lengths of the quat or any other compound herein, the commercial, polydisperse forms are contemplated. Thus, a given chain length within the preferred C_{14-18} range will be predominantly, but not exclusively, the specified length. The pyridinum and benzyldimethyl ammonium headgroups are not preferred if ionic strength is high. Also it is preferred that if R_1 is benzyl, R_2 and R_3 are not benzyl. Commercially available quats are usually associated with an anion. Such anions are fully compatable with the counterions of the present invention, and generally do not detract from the practice of the invention. Most typically, the anion is chloride and bromide, or methylsulfate. Where the cleaning active includes hypochlorite, however, the bromide anion is not preferred.

In preferred compositions, a quaternary ammonium compound is added at levels, which when combined with an organic counterion are thickening effective. Preferably about 0.1 10.0 weight percent of the quaternary ammonium compound is utilized, and more preferred is to use about 0.3 to 3% quat.

The organic counterion is preferably selected from the group consisting of C_{2-10} alkyl carboxylates, aryl carboxylates, C_{2-10} alkyl sulfonates, aryl sulfonates, sulfated C_{2-10} alkyl alcohols, sulfated aryl alcohols, and mixtures thereof. The aryl compounds are derived from benzene or napthalene and may be substituted or not. The alkyls may be branched or straight chain, and preferred are those having two to eight carbon atoms. The counterions may be added in acid form and converted to the anionic form in situ, or may be added in anionic form. Suitable substituents for the alkyls or aryls are C_{1-4} alkyl or alkoxy groups, halogens, nitro groups, and mixtures thereof. Substituents such as hydroxy or amine groups are suitable for use with some non-hypochlorite cleaning actives, such as solvents, surfactants and enzymes. If present, a substituent may be in any position on the rings. If benzene is used, the para (4) and meta (3) positions are preferred. The counterion is added in an amount sufficient to thicken and result in a viscoelastic rheology, and preferably between about 0.01 to 10 weight percent. A preferred mole ratio of quat to counterion is between about 12:1 and 1:6, and a more preferred ratio is about 6:1 to 1:3. Without limiting to a particular theory, it is thought that the counterion promotes the formation of elongated micelles of the quat. These micelles can form a network which results in efficient thickening. It has been surprisingly found that the viscoelastic thickening as defined herein occurs only when the counterion is minimally or non-surface active. Experimental data shows that, generally, the counterions of the present invention should be soluble in water. Surface-active counterions normally don't work, unless they have a critical micelle concentration (CMC) greater than about 0.1 molar as measured in water at room temperature (about 21 °C-(70 °F)). Counterions having a CMC less than this are generally too insoluble to be operable. For example, sodium and potassium salts of straight chain fatty acids (soaps), having a chain length of less than ten carbons. are suitable, however, longer chain length soaps generally don't work because their CMC's are less than about 0.1 molar. See Milton J. Rosen, Surfactants and Interfacial Phenomena, John Wiley and Sons.

Table 1 shows the effect on viscosity and phase stability of a number of different counterions. The quat in each example is CETAC, and about 5.5-5.8 weight percent sodium hypochlorite, 4-5 weight percent sodium chloride, and about 1,4-1.9 weight percent sodium hydroxide are also present.

Examples 15-25 and 44-47 of Table 1 show that viscosity depends on the ratio of counterion to quat. When the quat is CETAC and the counterion is 4-chlorobenzoic acid, maximum viscosity is obtained at a quat to counterion weight ratio of about 4:3. With CETAC and sodium xylene sulfonate, the ratio is about 5:1 by weight.

Preferred formulations of the present invention utilize a mixture of two or more counterions. Most preferably the counterion is a mixture of a carboxylate and a sulfonate, which surprisingly provides much better low temperature phase stability than either individually. As used herein sulfonate-containing counterions include the sulfated alcohol counterions. This is true even in the presence of the ionic strength. Examples of such mixtures are shown in Table II. Examples of preferred carboxylates are benzoate, 4-chlorobenzoate, napthoate, 4-toluate and octanoate. Preferred sulfonates include xylenesulfonate, 4-chlorobenzenesulfonate and toluene sulfonate. Most preferred is a mixture of at least one of the group consisting of 4-toluate, 4-chlorobenzoic acid and octanoate with sodium xylenesulfonate. A preferred ratio of carboxylate to sulfonate is betw en about 6:1 to 1:6, more preferred is between about 3:1 to 1:3. Mixtures of counterions may also act to synergestically increase viscosity, especially at low ratios of counterion to quat. Such syn rgism appears in some cases ev n if on of the count rions results in poor phas stability or low viscosity when used alone. For example, sampl s 11 and 46 of Tabl 1 (benzoic acid and sodium xyl n sulfonat , r sp ctively) yield low viscosities (2 mPa.s(cP) and 224 mPa.s (cP) r spectively) and are phase instable at -l °C (30 °F)). Wh n combin d, how v r as shown by sampl 3-5 of Tabl II. The formulations ar all phase stabl even at -18 °C (0 °F), and sampl 5 shows a much higher viscosity than

that of the same components individually.

Thickening can be enhanced, and low temperature phase stability improved, through the addition of a co-surfactant, as described in EP-A-88309272.

Table IV shows the effect of composition on rheology and corresponding drain cleaning performance. The latter is measured by two parameters: (1) percentage delivery; and (2) flow rate. Percentage delivery was measured by pouring 20mL of the composition, at 23°C (73°F), into 80 mL of standing water, and measuring the amount of undiluted product delivered. Flow rate was measured by pouring 100mL of the composition through a No. 230 US mesh screen and recording the time to pass through the screen. A delivery of 0% indicates that only diluted product, if any, has reached the clog; a 100% delivery indicates that all of the product substantially undiluted, has reached the clog. Rheology was measured with a Bolin VOR rheometer at 25°C (77°F) in the oscillatory mode. The viscosity is the in-phase component extrapolated to 0 Herz. The relaxation time, Tau, and the static shear modulus, GO, were calculated using the Maxwell model. The ratio Tau/GO is, as previously described, postulated to be a measure of relative elasticity.

The use of viscoelastic compositions according to the method of the present invention represents a substantial departure from the methods of the prior art in that elasticity, rather than simply viscosity, is the crucial parameter to the success of the invention. The viscoelastic thickener provides surprising advantag s when formulated as a drain cleaner. Because the elastic components hold the solution together. It will travel through standing water with very little dilution, delivering a high percentage of active to the clog. The elasticity results in a higher delivery rate of active than a purely viscous solution of the same viscosity. This is true even if the viscosity of the solution is low. Thus, viscosity alone will not result in good performance, but elasticity alone will, and a solution which is elastic and has some viscosity will result in superior performance. Such purely viscous solutions, further-more, do not achieve their highest delivery rates unless the viscosity is very high (above about 1000 mPa.s (cP)). This presents other problems, including difficulty in dispensing at low temperatures, poor penetration into clogs, reduced consumer acceptance, and high cost associated with attaining such high viscosities. The elasticity also yields increased percolation times through porous or partial clogs, surprisingly increasing the effectiveness of a drain opening composition.

Table V compares performance vs. rheology for five formulations: an unthickened control, a sarconsinate, non-viscoelastic thickened formulation, a slightly viscoelastic formulation of a surfactant and a soap, and two viscoelastic formulations of the present invention. The delivery and flow rate parameters were measured as in Table IV.

From Table V, it can be seen that formulas 1 and 2, which are not viscoelastic, have very low delivery values and high flow rates. This is true even though formula 2 is moderately thickened. The formulas of Table IV show that at a Tau/GO of about .03 or greater, a delivery percentage of above about 75% is attained. More preferred is a delivery percentage of above 90%. Thus, according to the method of the present invention, the composition should show a relative elasticity above about 0.03 sec:Pa, and preferred are values of above about 0.05 sec/Pa. A more preferred relative elasticity is above about 0.07 sec/Pa. A preferred flow rate is less than about 150mL minute, more preferred is less than about 100 mL/minute. It can also be seen from Tables IV and V that the relative elasticity of the composition, rather than viscosity, is crucial to drain opener performance. For example, Table V shows that despite having only about half the viscosity, formula 4 with a slightly higher relative elasticity far outperformed formula 3. Formulas 15 and 17 of Table IV also show that low viscosity formulas can display good drain opening performance as long as sufficient relative elasticity is present.

It is noted that viscosities reported herein are shear viscosities, i.e. those measured by a resistance to flow perpendicular to the stress vector. However, the parameter which most accurately defines the rheology of the present invention is extensional viscosity, i.e. uniaxial resistance to flow along the stress vector. Because a means of directly measuring extensional viscosity in solutions as described herein is not yet available, the relative elasticity parameter (Tau/GO) is used as an approximation. It is noted that if a means of measuring extensional viscosity becomes available, such means could be used to further define the scope of the present invention.

The maximum benefits of the viscoelastic rh ology of the drain cleaning composition are attained when the composition is denser than water, enabling it to penetrate standing water. While less dense compositions still benefit from the viscoelastic rheology when applied to drains having porous or partial clogs, the full benefit is obtained when the composition poss ss s a density greater than water. In many instances, this d nsity is attain d without th need for a densifying material. In formulations containing sodium hypochlorite, for xampl , suffici nt sodium chloride is pr sent with the hypochlorite to afford a d nsity gr ater than water. When necessary to increas the density, a salt such as sodium chloride is preferred and is added at levels of 0 to about 20%.

A preferred example of a drain cleaning composition comprises:

(a) an alkly quaternary ammonium compound having at least a C_{14} alkyl group;

(b) an organic counterion;

(c) an alkali metal hydroxide;

(d) an alkali metal silicate;

(e) an alkali metal carbonate; and

(f) an alkali metal hypochlorite

Components (a) and (b) comprise the viscoelastic thickener as described previously. The alkali metal hydroxide is preferably potassium or sodium hydroxide, and is present in an amount of between 0.5 and 20% percent. The preferred alkali metal silicate is one having the formula $M_2OSiO)_n$ where M is an alkali metal and n is between 1 and 4. Preferably M is sodium and n is 2.3. The alkali metal silicate is present in an amount of about 0 to 5 percent. The preferred alkali metal carbonate is sodium carbonate, at levels of between about 0 to 5 percent. About 1 to 10.0 percent hypochlorite is present, preferably about 4 to 8.0 percent.

Hypochlorite may also be incorporated into the drain opening composition, as previously described. The thick solutions are clear and transparent, and can have higher viscosities than hypochlorite solutions of the art. Because viscoelastic thickening is more efficient, less surfactant is needed to attain the viscosity, and chemical and physical stability of the composition generally is better. Less surfactant also results in a more cost-effective composition. Generally, the preferred quat for use with hypochlorite (or other source of ionic strength) is an alkyl trimethyl quaternary ammonium compound having a 14 to 18 carbon alkyl group, and most preferably the quat is CETAC. Owing to the relatively high ionic strength of the hypochlorite, it is preferred that R_1 R_2 and R_3 be relatively small, and methyls are more preferred. In the presence of hypochlorite, the composition is most stable when no more than about 1.0 weight percent quat is present, although up to about 10 weight percent quat can be used. Substituted benzoic acids are preferred as the counterion with 4-chlorobenzoic acid being more preferred. Most preferred are mixtures of 4-chlorobenzoic acid or 4-toluic acid with a sulfonate counterion, such as sodium xylenesulfonate. In the presence of bleach, hydroxyl, amino, and carbonyl substituents on the counterion should be avoided. Table VI shows hypochlorite and viscosity stability for various formulations having mixtures of counterions.

Table VII shows the mixture of carboxylate and sulfonate counterions results in a significant improvement in viscosity stability, as well as phase stability, over formulations of the art containing equal levels of hypochlorite. Formulas 1 and 2 are preferred compositions and retain essentially all of their initial viscosity after two weeks at 41 °C (106 °F), with Formula 2 showing only a slight decrease after 12 weeks at 41 °C (106 °F). By comparison, none of the other formulations retained even one-half of their initial viscosity after 12 weeks at 41 °C (106 °F).

A bleach source may be selected from various hypochlorite producing species, for example, halogen bleaches selected from the group consisting of the alkali metal and alkaline earth salts of hypohalite, haloamines, haloimines, haloimides and haloamides. All of these are believed to produce hypohalous bleaching species in situ. Hypochlorite and compounds producing hypochlorite in aqueous solution are preferred, although hypbromite is also suitable. Representative hypochlorite-producing compounds include sodium, potassium, lithium and calcium hypochlorite, chlorinated trisodium phosphate dodecahydrate, potassium and sodium dicholoroisocyanurate and trichlorocyanuric acid. Organic bleach sources suitable for use include hetero cyclic N-bromo and N-chloro imides such as trichlorocyanuric and tribromo-cyanuric acid, dibromo- and dicholorocyanuric acid, and potassium and sodium salts thereof. N-brominated and N-chlorinated succinimide, malonimide , phthalimide and naphthalimide. Also suitable are hydantoins, such as dibromo and dichloro dimethyl-hydantoin, chlorobromodimethyl hydantoin, N-chlorosulfamide (haloamide) and chloroamine (haloamine). Particularly preferred in this invention is sodium hypochlorite having the chemical formula NaOC1, in an amount ranging from about 0.1 weight percent to about 15 weight percent, more preferably about 0.2% to 10%, and most preferably about 2.0% to 6.0%

Advantageously, the viscoelastic thickener is not diminished by ionic strength, nor does it require ionic strength for thickening. Surprisingly, the viscoelastic compositions are phase-stable and retain their rheology in solutions with more than about 0.5 weight p rcentionizable salt, e.g., sodium chloride and sodium hypochlorite, corresponding to an ionic str ngth of about 0.09 g-ions Kg solution. Surprisingly, th composition rheology r mained stable at levels of ionizable salt of between about 5 and 20 percent, corresponding to an ionic strength of between about 1.4 g-ions Kg. It is xpect d that the visco lastic rheology would remain v n at ionic str ngths of at least about 6-g ions Kg. Table VIII shows the eff cts of a salt on viscosity and phase stability for a hypochlorite containing composition.

Buff rs and Ph adjusting agents may be add d to adjust or maintain pH, as disclosed in EP-A-88309272. The total amount of Buffer including that inh rently pr sent with bleach plus any added, can vary

from about 0.0% to 25%.

The composition can be formulated to include such components as fragrances, corrosion inhibitors, coloring agents, whiteners, solvents, chelating agents and builders, which enhance performance, stability or aesthetic appeal of the composition, as disclosed in EP-A-88309272.

Table I. Effect of Counterions

No.	CETAC Wt.%	Counterion Wt.%	Counterion Name	Viscosity mPas (cP) 3rpm	Viscosity mPas (cP) 30rpm	Number of Phases at Indicated Temp °C (°F) -11 (12)	-1 (30)	42 (107)	22 (71)	53 (127)
1	0.50		None	-	14	2	2	1		
2	0.50	0.010	Acetic Acid	90	74	2	2	1	1	1
3	0.50	0.200	Acetic Acid	100	81	2	2	1	1	1
4	0.50	0.050	Butyric Acid	100	76					
5	0.50	0.450	Butyric Acid	40	38	2	2	1	1	1
6	0.50	0.050	Octanoic Acid	50	40			1		
7	0.50	0.200	Octanoic Acid	80	74			1		
8	0.50	0.050	Sodium Octylsulfonate	220	165	2	2	1	1	1
9	0.50	0.100	Sodium Octylsulfonate	280	229	2	2	1	1	1
10	0.75	0.150	Sodium Octylsulfonate	400	353	2	2	1	1	1
11	0.48	0.180	Benzoic Acid	-	2		2	1	1	1
12	0.48	0.170	4-Toluic Acid	10	14		1C	1	1	1
13	0.22	0.200	4-Chlorobenzoic Acid	400	135	2	2	1	1	1
14	0.30	0.300	4-Chlorobenzoic Acid	960	202	2	2	1	1	1
15	0.50	0.050	4-Chlorobenzoic Acid	380	213	2	2	1	1	1
16	0.50	0.125	4-Chlorobenzoic Acid	2010	507			1		
17	0.50	0.200	4-Chlorobenzoic Acid	4450	850	2	2	1	1	1
18	0.50	0.250	4-Chlorobenzoic Acid	4180	820			1		
19	0.50	0.375	4-Chlorobenzoic Acid	5530	1000			1		
20	0.50	0.500	4-Chlorobenzoic Acid	4660	770			1		
22	0.50	0.625	4-Chlorobenzoic Acid	3180	606			1		
23	0.50	0.750	4-Chlorobenzoic Acid	1110	341			1		
24	0.50	0.875	4-Chlorobenzoic Acid	170	125			1		
25	0.50	1.000	4-Chlorobenzoic Acid	30	20			1		
26	0.70	0.100	4-Chlorobenzoic Acid	250	167	2	2	1	1	1
27	0.70	0.300	4-Chlorobenzoic Acid	4640	791	2	2	1	1	1
28	0.78	0.200	4-Chlorobenzoic Acid	3110	622	2	2	1	1	1
29	1.20	0.300	4-Chlorobenzoic Acid	940	685		2	1	1	1
30	0.50	0.200	2-Chlorobenzoic Acid	10	7		2	1	1	1
31	0.50	0.200	2,4-Dichlorobenzoic Acid	1920	658		2	1	1	1
32	0.50	0.200	4-Nitrobenzoic Acid	10	19		2	1	1	1
33	0.48	0.210	Salicylic acid	1040	359	1C	1C	1	1	1
34	0.50	0.150	Naphthoic Acid	750	306	2	1C	1		
35	0.50	0.030	Phthalic acid	70	73	2	2	1	1	1
36	0.50	0.400	Phthalic acid	80	64	2	2	1	1	1

Table I. Effect of Counterions (cont'd)

No.	CETAC Wt.%	Counterion Wt.%	Counterion Name	Viscosity mPas (cP) 3rpm	Viscosity mPas (cP) 30rpm	Number of Phases at Indicated Temp. °C (°F) -11 (12	-1 30	42 107	22 71	53 127)
37	0.50	0.100	Benzenesulfonic Acid	40	46	2	2	1		
38	0.50	0.200	Benzenesulfonic Acid	150	122	2	2	1		
39	0.50	0.400	Benzenesulfonic Acid	220	175	2	1C	1		
40	0.50	0.100	Toluenesulfonic Acid	360	223	2	2	1	1	1
41	0.50	0.200	Toluenesulfonic Acid	370	260	2	2	1	1	1
42	0.50	0.300	Toluenesulfonic Acid	290	238		2	1	1	1
43	0.50	0.150	Sodium Cumenesulfonate	thick				2		
44	0.50	0.030	Sodium Xylenesulfonate	150	119	2	2	2	1	1
45	0.50	0.100	Sodium Xylenesulfonate	610	279		2	1	1	1
46	0.50	0.150	Sodium Xylenesulfonate	260	224		2	1	1	1
47	0.50	0.200	Sodium Xylenesulfonate	130	123	2	2	1	1	1
48	0.97	0.630	Sodium Xylenesulfonate	100	120	1C	1	1	2	2
49	0.50	0.050	4-Chlorobenzenesulfonate	150	118	2	2	1		
50	0.50	0.100	4-Chlorobenzenesulfonate	420	248	2	1C	1		
51	0.50	0.200	4-Chlorobenzenesulfonate	140	149	2	2	1		
52	0.50	0.050	Methylnaphthalenesulfonate	290	202	2	2	1	1	1
53	0.50	0.100	Methylnaphthalenesulfonate	220	208	2	2	1	1	1
54	0.70	0.150	Methylnaphthalenesulfonate	480	390	2	2	1	1	1

CETAC = Cetyltrimethylammonium Chloride.

All formulas contain 0.113 wt.% of sodium silicate (SiO_2/Na_2O = 3.22); 5.5-5.8 % sodium hypochlorite, 4.3-4.7 wt. % sodium chloride and 1.4-1.9 wt.% sodium hydroxide.

Viscosities were measured at 22-27°C (72-81°F) with a Brookfield rotoviscometer model LVTD using spindle #2.

C = Cloudy

Table II. Effect of Mixed Counterions.

No.	CETAC Wt.%	Counterion Wt%	Counterion Name	Counterion Wt%	Counterion Name	Viscosity mPa.s(cP) 3rpm	Viscosity mPa.s(cP) 30rpm	Number of Phases at Indicated Temp (°F) °C (0) -18	12 -11	30 -1	71 22	107 42	(127) 53
1	0.50	0.20	Benzoic Acid	0.20	BSA	170	136	2	2	1C	1	1	1
2	0.50	0.20	Benzoic Acid	0.10	4-CBSA	1070	408	1F	1C	1C	1	1	1
3	0.60	0.24	Benzoic Acid	0.24	SXS	180	173	1F	1C	1	1	1	1
4	0.62	0.10	Benzoic Acid	0.32	SXS	100	74	1C	1C	1	1	1	1
5	0.62	0.45	Benzoic Acid	0.15	SXS	690	424	1C	1C	1	1	1	1
6	0.52	0.09	4-CBA	0.20	Benzoic Acid	1340	429	1F	1C	1C	1	1	1
7	0.62	0.09	4-CBA	0.30	p-Toluic Acid	7680	2440	2	2	2	1	1	1
8	0.62	0.09	4-CBA	0.20	2-CBA	1160	414	1C	2	1C	1	1	1
9	0.62	0.09	4-CBA	0.20	4-NBA	840	387	1C	1C	1	1	1	1
10	0.31	0.05	4-CBA	0.10	Naphthoic Acid	790	290	1F	1C	1	1	1	1
11	0.62	0.09	4-CBA	0.10	Naphthoic Acid	3400	1025	1F	1C	1C	1	1	1
12	0.62	0.09	4-CBA	0.30	Naphthoic Acid	5560	2360	2	2	1	1	1	1
13	0.50	0.10	4-CBA	0.15	Octanoic Acid	60	54						
14	0.62	0.09	4-CBA	0.20	BSA	2410	695	1F	1C	1C	1	1	1
15	0.15	0.05	4-CBA	0.05	TSA	140	56	2	2	2	1	1	1
16	0.30	0.10	4-CBA	0.10	TSA	1140	270	2	2	1	1	1	1
17	0.50	0.20	4-CBA	0.10	TSA	2520	625	2	2	2	1	1	1
18	0.30	0.08	4-CBA	0.08	SXS	400	142	2	2	1	1	1	1
19	0.30	0.10	4-CBA	0.10	SXS	635	142	2	2	2	1	1	1
20	0.30	0.12	4-CBA	0.30	SXS	200	140	1F	1	1	1	1	1
21	0.37	0.11	4-CBA	0.22	SXS	470	270	2	1	1	1	1	1
22	0.48	0.06	4-CBA	0.32	SXS	80	91	1F	1C	1	1	1	1
23	0.50	0.10	4-CBA	0.18	SXS	440	344	1F	1C	1	1	1	1
24	0.50	0.10	4-CBA	0.10	SXS	1100	313	2	2	2	1	1	1
25	0.50	0.12	4-CBA	0.35	SXS	402	320	1F	1	1	1	1	1
26	0.50	0.13	4-CBA	0.50	SXS	250	221	1F	1	1	1	1	1
27	0.50	0.15	4-CBA	0.15	SXS	4760	1620	2	2	1	1	1	1
28	0.50	0.15	4-CBA	0.25	SXS	970	382	2	2	1	1	1	1
29	0.50	0.15	4-CBA	0.50	SXS	470	350	1F	1	1	1	1	1
30	0.50	0.38	4-CBA	1.13	SXS	60	45		1	1	1	1	1
31	0.69	0.17	4-CBA	0.45	SXS	720	576	1C	1	1	1	1	1
32	0.69	0.20	4-CBA	0.40	SXS	3140	894	1F	1	1	1	1	1
33	0.82	0.13	4-CBA	0.35	SXS	440	450	1F	1C	1	1	1	1
34	0.89	0.09	4-CBA	0.31	SXS	520	531	1C	2	1	1	1	1

Table II. Effect of Mixed Counterions. (Cont'd)

No.	CETAC Wt.%	Counterion Wt%	Counterion Name	Counterion Wt%	Counterion Name	Viscosity mPa.s(cP) 3rpm	Viscosity mPa.s(cP) 30rpm	Number of Phases at Indicated Temp (°F)°C (0) -18	(12) -11	(30) -1	(71) 22	(107) 42	(127) 53
35	0.90	0.13	4-CBA	0.26	SXS	1950	1630	2	2	1	1	1	1
36	0.50	0.10	2-CBA	0.15	SXS	140	128	1F	2	1C	1	1	1
37	0.[illegible]2	0.10	2,4-D	0.32	SXS	100	86	1F	1C	1	1	1	1
38	0.50	0.10	4-NBA	0.20	BSA	310	206	1F	2	1C	1	1	1
39	0.50	0.10	4-NBA	0.05	4-CBSA	360	200	1F	2	1C	1	1	1
40	0.62	0.12	4-NBA	0.32	SXS	100	95	1F	1C	1	1	1	1
41	0.50	0.20	Phthalic acid	0.10	SXS	180	165		2	2	1	1	1
42	0.15	0.05	Naphthoic Acid	0.05	SXS	40	27	1F	1C	1	1	1	1
43	0.20	0.10	Napnthoic Acid	0.10	SXS	90	54	2	1C	1	1	1	1
44	0.40	0.10	Naphthoic Acid	0.20	SXS	110	100	1C	1C	1	1	1	1
45	0.60	0.10	Naphthoic Acid	0.20	SXS	340	294	2	2	1	1	1	1
46	0.62	0.15	Naphthoic Acid	0.32	SXS	160	141	1C	1C	1	1	1	1
47	0.50	0.10	Naphthoic Acid	0.10	4-CBSA	1210	356	1F	1C	1	1	1	1
48	0.50	0.15	SXS	0.20	BSA	190	135	2	2	1C	1	1	1
49	0.50	0.04	SXS	0.06	TSA	400	212	2	2	2	1	1	1
50	0.50	0.12	SXS	0.08	TSA	250	224	2		1	1	1	1
51	0.50	0.12	SXS	0.18	TSA	170	150	2	2	2	1	1	1
52	0.50	0.15	SXS	0.05	4-CBSA	90	82	2	1C	1	1	1	1
53	0.50	0.05	Octanoic Acid	0.20	SXS	180	166	1F	1C	1	1	1	1
54	0.50	0.10	Octanoic Acid	0.15	SXS	310	248	2	1C	1	1	1	1
55	0.60	0.15	Octanoic Acid	0.10	SXS	340	283	2	1C	1C	1	1	1
56	0.50	0.15	Octanoic Acid	0.20	SXS	210	175	1F	1C	1	1	1	1
57	0.50	0.20	Octanoic Acid	0.10	SXS	160	135	1F	1C	1	1	1	1
58	0.50	0.06	Na Octylsulfonate	0.06	MNS	200	182	2	2	2	1	1	1

CETAC = Cetyltrimethylammonium Chloride.

All formulas contain 0.113 wt.% of sodium silicate (SiO_2 / Na_2O = 3.22); 5.6-5.8 wt. % sodium hypochlorite; 4-5 wt. % sodium chloride and 1.7-1.8 wt. % sodium hydroxide

Viscosities were measured at 22-27°C (72-81°F) with a Brookfield rotoviscometer model LVTD using spindle ≠ 2.

4-CBA = 4-Chlorobenzoic Acid
SXS = Sodium Xylenesulfonate
BSA = Benzenesulfonic Acid
TSA = Toluenesulfonic Acid
4-CBSA = 4-Chlorobenzenesulfonic Acid
2-CBA = 2-Chlorobenzoic Acid
2,4-D = 2,4-Dichlorobenzoic Acid
4-NBA = 4-Nitrobenzoic Acid
MNS = Methylnaphthalenesulfonate

C = Cloudy
F = Frozen

Table III. Effect of Cosurfactants

No.	CETAC Wt.%	Cosurfactant Wt.%	Cosurfactant Name	4-CBA Wt.%	SXS Wt.%	Viscosity mPa.s(cP) 3rpm	Viscosity mPa.s(cP) 30rpm	Number of Phases at Indicated Temp °C (°F) -18 (0)	-11 (12)	-1 (30)	22 (71)	42 (107)	53 (127)
1	0.30	0.02	Lauryl DMAO	0.12	0.22	580	202	1F	1	1	1	1	1
2	0.30	0.04	Lauryl DMAO	0.12	0.22	490	226	1F	1	1	1	1	1
3	0.50	0.10	Lauryl DMAO	0.20	0	930	327	2	1C	1	1	1	1
4	0.50	0.20	Lauryl DMAO	0.20	0	20	23				1		
5	0.24	0.06	Myristyl DMAO	0.08	0.14	480	165	1F	1	1	1	1	1
6	0.24	0.08	Myristyl DMAO	0.08	0.14	530	183	1F	1	1	1	1	1
7	0.30	0.03	Myristyl DMAO	0.10	0.18	520	193	1F	1	1	1	1	1
8	0.30	0.06	Myristyl DMAO	0.10	0.18	760	230	1F	1	1	1	1	1
9	0.30	0.15	Myristyl/Cetyl DMAO	0.08	0.08	940	295	2	2	1C	1	1	1
10	0.30	0.25	Myristyl/Cetyl DMAO	0.08	0.08	750	313	2	2	1C	1	1	1
11	0.30	0.04	Myristyl/Cetyl DMAO	0.10	0.10	1100	223	2	2	1	1	1	1
12	0.50	0.25	Myristyl/Cetyl DMAO	0.10	0.10	3800	779	2	2	1C	1	1	1
13	0.50	0.10	Myristyl/Cetyl DMAO	0.20	0	3420	640	1F	1C	1	1	1	1
14	0.50	0.20	Myristyl/Cetyl DMAO	0.20	0	2540	545				1		
15	0.50	0.10	Lauroyl Sarcosine	0.12	0.35	380	355		1C	1	1	1	1
16	0.50	0.10	Cetoylmethyltaurate	0.12	0.35	200	196		1C	1C	1	2	2
17	0.50	0.10	Cetoylmethyltaurate	0.12	0.70	230	214		1C	1C	1	1	1
18	0.50	0.10	Cetylbetaine	0.12	0.35	580	456	1F	1C	1	1	1	2
19	0.50	0.10	Laurylbetaine	0.12	0.35	740	443		1	1	1	1	1
20	0.42	0.08	Dodecyl TAC	0.15	0.35	450	339		1	1	1	1	1
21	0.38	0.12	Dodecyl TAC	0.15	0.35	190	180		1	1	1	1	1
22	0.42	0.08	Coco TAC	0.15	0.35	610	385		1	1	1	1	1
23	0.38	0.12	Coco TAC	0.15	0.35	310	239		1	1	1	1	1
24	0	0.50	Dodecyl TAC	0.15	0.35	Thin					1		
25	0	1.00	Dodecyl TAC	0.30	0.35	Thin					1		
26	0	0.25	Myristyl/Cetyl DMAO	0.10	0.10	1	5	1F	1	1	1	1	1
27	0	0.50	Laurylbetaine	0.15	0.35	1	5		1	1	1	1	1

DMAO = Dimethylamine oxide
TAC = Trimethylammonium Chloride
CETAC = Cetyltrimethylammonium Chloride
4-CBA = 4-Chlorobenzoic Acid
SXS = Sodium Xylenesulfonate
C = Cloudy
F = Frozen

All formulas contain 5.8 wt.% of sodium hypochlorite, 1.5 wt.% of sodium hydroxide, 4.5 wt. % sodium chloride, 0.25 wt. % sodium carbonate and 0.113 wt.% of sodium silicate (SiO_2 /Na_2O = 3.22)

Viscosities were measured at 22-27°C (72-81°F) with a Brookfield rotoviscometer model LVTD using spindle # 2.

Table IV. Effect of Composition on Rheology and Drain Opener Performance.

No.	CETAC Wt%	SXS Wt%	Counterion Wt%	Counterion Type	Viscosity mPas(cP)	Tau sec	G0 Pa	Tau/G0 sec/Pa	Delivery %	Flow Rate mL/min
1	0.370	0.260	0.080	CBA	47	0.33	0.93	0.35	—	—
2	0.500	0.143	0.071	CBA	247	0.84	1.86	0.45	96	46
3	0.500	0.286	0.071	CBA	84	0.20	2.66	0.08	73	150
4	0.500	0.350	0.120	CBA	153	0.47	2.11	0.22	96	33
5	0.500	0.315	0.132	CBA	560	1.29	1.83	0.71	—	—
6	0.625	0.125	0.063	CBA	716	2.00	2.25	0.89	96	27
7	0.625	0.250	0.063	CBA	140	0.23	3.94	0.06	74	109
8	0.625	0.313	0.156	CBA	390	0.67	3.65	0.18	96	26
9	0.625	0.625	0.156	CBA	302	0.53	3.63	0.15	86	33
10	0.670	0.310	0.085	CBA	142	0.20	4.56	0.04	—	43
11	0.750	0.225	0.075	CBA	327	0.44	4.77	0.09	87	67
12	0.750	0.214	0.107	CBA	478	0.66	4.57	0.14	95	34
13	0.750	0.428	0.107	CBA	147	0.16	5.68	0.03	78	100
14	0.750	0.562	0.188	CBA	587	0.69	5.36	0.13	94	27
15	0.100	0.050	0.050	NA	7	0.08	0.23	0.35	74	133
16	0.150	0.050	0.050	NA	26	0.26	0.26	1.00	82	80
17	0.200	0.100	0.050	NA	21	0.64	0.22	2.91	90	120
18	0.200	0.100	0.100	NA	43	0.98	0.24	4.08	90	46
19	0.400	0.200	0.100	NA	71	0.42	1.07	0.39	94	52
20	0.600	0.200	0.100	NA	244	0.60	2.64	0.23	97	27
21	0.400	0.130	0.160	BA	116	0.83	0.83	0.99	91	48
22	0.500	0.200	0.290	BA	166	0.73	1.41	0.52	94	32
23	0.600	0.240	0.160	BA	94	0.27	2.32	0.12	81	71
24	0.600	0.300	0.380	BA	128	0.36	2.32	0.16	93	34
25	0.600	0.250	0.150	TA	137	0.26	3.22	0.08	91	63
26	0.600	0.400	0.150	TA	46	0.13	2.20	0.06	68	109
27	0.600	0.400	0.300	TA	178	0.42	2.62	0.16	93	36

CETAC = Cetyltrimethylammonium Chloride; SXS = Sodium Xylenesulfonate; CBA = 4-Chlorobenzoic Acid; NA = 1-Naphthoic Acid; BA = Benzoic Acid; TA = 4-Toluic Acid.

All formulas contain 5.8 wt.% sodium hypochlorite NaOCl, 4.55 wt.% Cl sodium cchloride, 0.25 wt.% sodium carbonate, 1.5 wt.% sodium hydroxide, and 0.113 wt.% of sodium silicate (SiO/Na_2O = 3.22).

Table V. Performance Versus Rheology

Formula	Rheology	Viscosity mPa.s(cP)	Tau sec	G0 Pa	Tau/G0 sec/Pa	Delivery[b] %	Flow Rate[c] mL/min
1	unthickened	1	0	0	0	0	2400
2	thickened nonelastic	141	0.12	7.64	0.016	6	92
3	smooth	334	0.35	6.06	0.058	47	52
4	elastic	140	0.26	3.48	0.075	93	55
5	elastic	153	0.47	2.11	0.223	96	33

b. Percentage of product that passes through standing water to the clog. Twenty mL of product at 23°C (73°F) was poured into 80 mL of standing water.

c. Rate of Flow for product at 23°C (73°F) through a 230 mesh sieve.

Formula	Wt.%	Compound	Wt.%	Compound	Wt.%	Compound
1	contains no thickeners					
2	1.6	MDMAO	0.37	Sarcosinate(1)	0.03	Primacor 5980(2)
3	0.8	MDMAO	0.25	Lauric Acid	-	-
4	0.62	CETAC	0.09	4-CBA	0.29	SXS
5	0.50	CETAC	.12	4-CBA	0.35	SXS

(1) Sodium lauroyl sarcosinate
(2) A trademarked product of the Dow Chemical Co., comprising a copolymer of acrylic acid and ethylene

All formulas contain 5.8 wt. % sodium hypochlorite, 1.75 wt. % sodium hydroxide and 0.11 wt. % sodium silicate (SiO_2/Na_2O = 3.22).

MDMAO = Myristyldimethylamine oxide
CETAC = Cetyltrimethyl ammonium chloride
4-CBA = 4-chlorobenzoic acid
SXS = Sodium Xylenesulfonate

Table VI. Stability at 120°F.

No.	CETAC Wt%	Counterion Wt%	Counterion Name	Counterion Wt%	Counterion Name	Viscosity mPa.s(cP)	% Remaining at (120°F) 49°C Viscosity 1wk	Viscosity 2wk	NaOCl 1wk	NaOCl 2wk
1	0.50	0.20	BSA	0.10	4-NBA	206	75		75	
2	0.50	0.20	BSA	0.20	Benzoic Acid	136	95		75	
3	0.50	0.20	BSA	0.15	SXS	135	74		74	
4	0.50	0.05	4-CBSA	0.10	4-NBA	200	75		75	
5	0.50	0.05	4-CBSA	0.10	Benzoic Acid	158	96		74	
6	0.50	0.05	4-CBSA	0.30	Benzoic Acid	205	94		75	
7	0.50	0.05	4-CBSA	0.15	SXS	82	76		76	
8	0.30	0.12	4-CBA	0.30	SXS	184	93	63		60
9	0.40	0.12	4-CBA	0.28	SXS	300	82	74		60
10	0.52	0.09	4-CBA	0.29	SXS	180	91	98	79	64
11	0.50	0.12	4-CBA	0.28	SXS	346	99			
12	0.50	0.15	4-CBA	0.35	SXS	413	93	67		59
13	0.62	0.09	4-CBA	0.29	SXS	235	85	85	76	60
14	0.72	0.04	4-CBA	0.29	SXS	316	77	76	78	62
15	0.30	0.05	NA	0.05	SXS	118	44		76	
16	0.30	0.10	NA	0.10	SXS	120	48		76	
17	0.48	0.21	SA		None	280	0			
	Control		None		None				79	65

All formulas contain 5.2-5.8 wt. % sodium hypochlorite, 1.6-1.8 wt. % sodium hydroxide, about 4-5 wt. % sodium chloride, 0.25 wt. % sodium carbonate and 0.113 wt.% of sodium silicate (SiO_2 / Na_2O = 3.22).

Viscosities were measured at 22-24°C/(72-76°F) with a Brookfield rotoviscometer model LVTD using spindle # 2 at 30 rpm.

4-CBA = 4-Chlorobenzoic Acid
4-CBSA = 4-Chlorobenzenesulfonic Acid
SXS = Sodium Xylenesulfonate
2-CBA = 2-Chlorobenzoic Acid
BSA = Benzenesulfonic Acid
NA = Naphthoic Acid
SA = Salicylic Acid
4-NBA = 4-Nitrobenzoic Acid

Table VII Viscosity Stability Compared to Other Formulas

Thickening System	Initial Viscosity mPa.s(cP)	Percent Viscosity Left: Weeks at 41°C (106°F) 1	2	4	8	12
1	320	101	99	N/A	104	100
2	203	N/A	94	N/A	87	84
3	358	85	92	74	63	N/A
4	309	N/A	96	56	53	42
5	304	N/A	57	29	16	11
6	335	N/A	77	64	49	45

All formulas contain 4.5-5.8 wt.% of sodium hypochlorite, 1.5-1.8 wt.% of sodium hydroxide, 3.5-4.6 wt.% of sodium chloride, 0.25 wt.% of sodium carbonate, and 0.11-0.45 wt.% of sodium silicate (SiO_2/Na_2O = 3.22).

Viscosities were measured at 22-24°C/(72-75°F) with a Brookfield rotoviscometer model LVTD using cylindrical spindle #2 at 30 rpm.

(1) contains 0.05 wt.% Cetyltrimethylammonium Chloride, 0.12 wt.% 4-Chlorobenzoic acid and 0.35 wt.% Sodium xylene sulfonate.

(2) contains 0.62 wt.% Cetyltrimethylammonium Chloride, 0.09 wt.% 4-Chlorobenzoic acid and 0.29 wt.% Sodium xylene sulfonate.

(3) contains 0.97 wt.% Sodium lauryl sulfate, 0.30 wt.% Sodium lauroyl sarcosinate and 0.30 wt.% Sodium lauryl ether sulfate.

(4) contains 0.60 wt.% Myristyl/cetyldimethylamine oxide, 0.20 wt.% Capric acid and 0.10 wt.% Lauric acid.

(5) contains 0.65 wt.% Myristyl/cetyldimethylamine oxide and 0.20 wt.% Sodium alkylnaphthalene sulfonate.

(6) contains 1.00 wt.% Myristyl/cetyldimethylamine oxide, 0.25 wt.% Sodium xylene sulfonate and 0.35 wt.% Disodium dodecyldiphenyl oxide disulfonate.

Table VIII

Formula	Weight Percent 1	2	3	4
CETAC	0.50	0.50	0.50	0.50
4-Chlorobenzoic Acid	0.13	0.13	0.13	0.13
Sodium Xylenesulfonate	0.32	0.32	0.32	0.32
Sodium Hypochlorite	5.80	5.80	5.80	5.80
Sodium Hydroxide	1.75	1.75	1.75	1.75
Sodium Silicate (SiO_2/Na_2O = 3.22)	0.11	0.11	0.11	0.11
Sodium Carbonate	0.25	0.25	0.25	0.25
Sodium Chloride[a]	4.55	5.80	7.05	9.55
Ionic Strength, g-ions/Kg	2.42	2.71	3.00	3.61
Viscosity[b], mPa.s (cP)				
3 rpm	600	680	820	1120
30 rpm	385	386	384	388
Number of Phases				
-12°C (10°F)	1C	1C	1	1
-1°C (30°F)	1	1	1	1
21°C (70°F)	1	1	1	1
38°C (100°F)	1	1	1	1
52°C (125°F)	2	1	1	1

a. Includes salt from the manufacture of sodium hypochlorite.

b. Viscosities were measured at 22°C/(72°F) with a Brookfield rotoviscometer model LVTD using spindle # 2.

C = Cloudy

Claims

1. A method for clearing restrictions caused by organic materials in drain pipes comprising:
   (a) introducing to a drain pipe having an organic restriction therein a drain opening composition comprising a cleaning active and a viscoelastic thickening system wherein the composition has a relative elasticity of greater than about 0.03 sec/Pa;
   (b) allowing the composition to remain in contact with the organic restriction material to react therewith; and
   (c) rinsing the composition and restriction away.

2. A method as claimed in claim 1 characterised in that the composition has a density great r than that of water.

3. A method as claimed in claim 1 or claim 2, characteris d in that the composition has a viscosity of at least about 20 mPa.s(cP).

4. A m thod as claim d in any of claims 1-3 charact rised in that the composition ionic strength is at l ast ab ut 0.09 g-ions/kg.

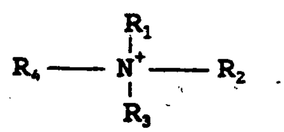
5. A method as claimed in any of claims 1-4 characterised in that the composition has a delivery rate of greater than about 70%, as determined in the manner as herein described.

6. A method as claimed in any of claims 1-5 characterised in that the drain opening active is selected from acids, bases, oxidants, reductants, solvents, enzymes, detergents, thioorganic compounds, and mixtures thereof.

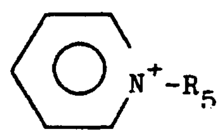
7. A method as claimed in any of claims 1-6 characterised in that the viscoelastic thickener comprises a quaternary ammonium compound and an organic counterion.

8. A method as claimed in claim 7 characterised in that the quaternary ammonium compound is selected from compounds having the following structures:-

(i)



(ii)



and;

(iii) and mixtures thereof;

wherein R_1, R_2 and R_3 are the same or different and are methyl, ethyl, propyl, isopropyl or benzyl, R_4 is C_{14-18} alkyl, and R_5 is C_{14-18} alkyl, and;

the organic counterion is selected from the group consisting of alkyl and aryl carboxylates, alkyl and aryl sulfonates, sulfated, alkyl and aryl alcohols, and mixtures thereof; and wherein the quaternary ammonium compound and organic counterion are present in an amount sufficient to thicken and result in a viscoelastic rheology.

9. A method as claimed in claim 7 or claim 8 characterised in that the cleaning active is present in an amount of from about 0.05% to 50%; the quaternary ammonium compound is present from about 0.1 to 10%; and the organic counterion is present in a mole ratio to the quaternary ammonium compound of between about 6:1 and 1:12.

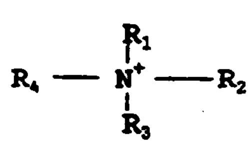
10. A method as claimed in claim 9, characterised in that the organic counterion comprises a mixture of at least one carboxylate-containing counterion and at least one sulfate- or sulfonate-containing counterion.

11. A method as claimed in any of claims 1-10 characterised in that the composition comprises aqueous solution:

(a) an alkali metal hydroxide;

(b) an alkali metal hypochlorite

(c) a quaternary ammonium compound having the following structure:



wherein R_1, R_2 and R_3 are the same or different and are methyl, ethyl, propyl, isopropyl or benzyl, R_4 is C_{14-18} alkyl; and
(d) an organic counterion, selected from alkly and aryl carboxylates, alkyl and aryl sulfonates, sulfated alkyl and aryl alcohols and mixtures thereof; and wherein (c) and (d) are present in an amount sufficient to thicken and result in a viscoelastic rheology.

12. A method as claimed in claim 11 characterised in that the composition further includes 0 to about 5 weight percent of an alkali metal silicate, and 0 to about 5 weight percent of an alkali metal carbonate.

13. A method as claimed in claim 11 or claim 12 characterised in that component (a) is present in an amount of from about 0.5 to 20 weight percent; component (b) is present in an amount of from about 1 to 10 weight percent; component (c) is present from about 0.1 to 10 weight percent; and component (d) is present from 0.1 to about weight percent.

14. A method as claimed in any of claims 1 to 13 characterised in that the composition comprises:
(a) 0.5 to 20 weight percent of an alkali metal hydroxide
(b) 1 to 10 weight percent alkali metal hypochlorite;

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 20 2215

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.4)
A	GB-A-2 185 036 (BRISTOL-MYERS COMPANY) * page 2, line 39 - line 40 * * page 3, line 26 - line 37 * ---	1,3,4,6, 11-14	C11D1/62 C11D3/00 C11D17/00
A	US-A-4 388 204 (H.L. DIMOND) * column 1, line 9 - line 15 * * column 6, line 54 - line 63 * * column 11, line 22 - line 32 * * column 12, line 3 - line 38 * ---	1,3,6, 11-14	
D,A	US-A-4 587 032 (T.A. ROGERS) * column 3, line 51 - line 57 * * column 4, line 24 - line 27 * * column 5, line 27 - line 32 * * column 5, line 38 - line 42 * * column 5, line 53 - line 55 * ---	1,2,6-9	
D,A	US-A-3 503 890 (M.C DAVISSON) * column 2, line 15 - line 59 * * column 4, line 18 - line 29 * * claim 9 * ---	1,6-9,11	TECHNICAL FIELDS SEARCHED (Int.Cl.4) C11D
D,A	GB-A-1 466 560 (JEYES GROUP LIMITED) * page 1, line 17 - line 43 * * page 2, line 44 - line 65 * * claims 1,7,9 * -----	1,6,7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 November 1993	HILGENGA, K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document